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ABSTRACT

Based on interviews with state administrators and local educators in four states that are actively implementing skills standards in secondary and postsecondary education, this report describes strategies for using industry skill standards to improve education. Following introductory materials, strategies are reviewed for overcoming obstacles to the use of skill standards in education, such as inconsistent state and national skill standard frameworks, low skill levels in standards, and the lack of infrastructure for curriculum and instructional development. Strategies covered in this section include developing a common lexicon, occupational clusters, and exemplary models to resolve inconsistent standards; raising academic skills levels in industry-developed standards; and developing inventories of instructional applications and on-line databases of standards. The following two key practices used by the four states to promote and implement skill standards are then discussed: building statewide support for the development of standards by involving the private sector and providing educators with flexibility in using standards, as well as aligning curriculum and assessment through the use of standards to organize instruction. A discussion is then provided of issues related to implementing skill standards in professional education programs, highlighting the importance of faculty involvement in curricular design and alternative performance assessment techniques, such as assessing workplace performance or certification exams. Finally, recommendations are provided for coordinating efforts to develop industry skill standards. Contains 11 references. (HAA)

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APPLYING THE STANDARD:
USING INDUSTRY SKILL STANDARDS TO IMPROVE CURRICULUM AND INSTRUCTION

Lessons Learned from Early Implementers in Four States

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Management Planning Research

APPLYING THE STANDARD:
USING INDUSTRY SKILL STANDARDS TO IMPROVE CURRICULUM AND INSTRUCTION

Lessons Learned from Early Implementers in Four States

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Introduction

Skill standards are receiving considerable attention as a potential tool for work force development and education reform. At the national level, federal grants to industry pilot projects, the funding of a National Skill Standards Board, and legislation encouraging partnerships between business and schools are catalyzing efforts to define industry standards. Moreover, in a number of states, industry representatives are collaborating with state policymakers to create frameworks and identify skill standards that can influence the content of education curricula and instruction. To date, much of the resulting discussion has addressed philosophical issues regarding the best approach for grouping standards—by industry or occupational skills—and how to structure a system to promote the national development of standards. In many cases, the skill standards that have been identified emphasize the technical skills and knowledge that entry-level workers will need for immediate labor market success.

The potential for skill standards to strengthen education rests on their acceptance in mainstream curriculum and pedagogy. If industry standards are to be embraced by educators, then skill standards must be linked with academic as well as vocational subject areas and address broad issues of career preparation. Although states share the common goal of preparing students for postsecondary education and career entry, state policymakers are using a variety of approaches to define standards. Some have taken a traditional task analysis approach to specify detailed lists of technical skills associated with specific jobs, while others have sought to define standards more generally, identifying the broad "knowledge and skills" that encompass a cluster of occupations and industries. While there is no one right way to draft standards, ultimately the manner in which skills are specified can affect how the system evolves at the local, state, and national levels.

To better understand these issues, a team of researchers conducted a series of case studies in four states experienced in developing and implementing skill standards for use in secondary and postsecondary education. Initial discussions with state administrators and participating private-sector employers focused on identifying state goals and objectives for skill standards—the organizing framework for developing industry standards—and key participants and their respective roles in the standards-drafting process. In subsequent visits with secondary and postsecondary educators, the research team examined the role of industry standards in curriculum development, and studied how standards affect instructional practice, professional development, and performance assessment.

BACKGROUND

As technical advances and international competition combine to alter the traditional workplace, employers are increasingly seeking skilled individuals who can adapt to changing marketplace conditions. The perception that many Americans lack the academic and general work-readiness skills to function in emerging, technologically advanced work environments has led policymakers to call for the creation of broadly conceived skill standards that can be used to direct the education and training of individuals for industry success. To help identify these standards, federal and state officials have been working with representatives from the private and public sectors to specify core skills that underlie different careers in various industry and occupational fields.

Federal efforts to promote voluntary national skill standards have focused on providing fiscal resources to support system development. In 1992, the U.S. Departments of Education and Labor awarded grants to 22 national industry skill standards pilot projects. Technical committees, made up of representatives from business, labor, and education, worked to identify the skill needs of entry-level and, in some instances, advanced-level workers within participating industries. Outlining the expectations for occupational skill competency, these voluntary standards are intended to communicate to employers, unions, workers, and educators the skills that workers at all skill levels must know and be able to do.

Currently, several national initiatives are providing support to assist all Americans in achieving high academic and occupational standards. Specifically, the National Skill Standards Board, established under the *Goals 2000: Education America Act*, is working toward developing and adopting a voluntary national system of recognized industry skill standards. Representatives of business, trade associations, and organized labor are presently working with the Board to identify a framework for selecting and defining occupational–industry clusters around which standards will be developed. In addition, the *School-to-Work Opportunities Act* complements Goals 2000 reform efforts by encouraging educators to form partnerships with public- and private-sector organizations to support work-based learning for students.

In the absence of federal funding for a National Education Standards and Improvement Council, which was to have certified national academic content and student performance standards, national disciplinary and specialty associations have assumed much of the responsibility for creating subject area standards. National standards have been developed in mathematics, history, health, geography, physical education, civics, social studies, science, English, the arts, and foreign language, with many of these efforts benefiting from state curriculum framework initiatives that preceded them. While academic standards have been drafted by prominent academic leaders in each field, some of the proposed standards

have drawn considerable criticism. Typically, subjects that address political, social, or ethical issues (e.g., history) have been the most controversial. While it is still too early to assess their impact, it would appear that the national academic standards will ultimately serve as a resource that state and local authorities, curriculum developers, textbook publishers, and teachers will consult as they design curriculum and assessment materials.

States are also exploring the use of skill standards—industry and academic—for education reform and work force development. Industry standards are typically developed by boards of private-sector representatives, whose membership reflects the state's economic makeup. While national industry standards are often studied by these groups, and in some cases adapted either in part or in their entirety, it is more often the case that completely new sets of standards are generated to reflect individual states' particular preferences. Variation in conceptual frameworks and skill specificity often means that the development of state standards proceeds among divergent pathways.

In some states, initial efforts to develop standards stress defining skills for specific occupations, or groups of closely related occupations, with the intent of later "clustering" them into broad industry sectors when standards specifications are complete. In contrast, other states have started by identifying relatively broad industry clusters—such as Engineering/Technologies—that will be used to deduce standards for all careers within an industry or related industries within a broad industry sector. It is not clear that one strategy is inherently better than the other. What is apparent, however, is that the type of framework used to define standards can have important implications for subsequent state work, and may ultimately influence the specificity of a state's industry standards and how they are organized.

While integrating industry standards into education can enhance American economic competitiveness and improve the quality of teaching and learning, federal and state efforts to develop standards often ignore a fundamental tension that exists between standards designed for career readiness and those intended to promote the mastery of academic knowledge and skills. A key issue relates to the manner in which industry skill standards are framed for use by educators: standards with a strong occupational focus may have limited potential for preparing youth for further education and career exploration, while standards that are defined too generally may fail to offer a real-world context that captures students' interest.

Structure of This Report

This report is organized into three sections that explore how industry skill standards can be used to improve education. It opens with a review of practical problems that state and local policymakers are encountering in their efforts to develop industry standards that can inform curricular design and classroom instruction. Site visits to four states—Illinois, New York, Oklahoma, and Washington—indicate that in the absence of supporting materials and instructional guidelines, many teachers are struggling to implement state and national industry standards. In this report, conversations with educators who have experience working with such standards are used to identify obstacles that states and localities are encountering in their efforts to integrate skill standards into elementary, secondary, or postsecondary programs.

The discussion then shifts to identify successful practices that policymakers and educators are employing to promote the use of industry standards in teaching and learning. Case study data illustrate strategies that states are using to build widespread support for developing standards, and to use standards to align curriculum and assessment. Here the emphasis is on describing the benefits and arraying the trade-offs of approaching standards development from an industry or education perspective.

Although most groups are still in the early stages of developing their standards, some seem to implicitly assume that industry standards are most appropriate for students considering employment in careers requiring less than a baccalaureate degree. However, industry standards have long been used in four-year colleges and universities to prepare undergraduate and graduate students to enter a profession. To explore how industry skill standards might be used to improve teaching and learning, this report closes with a discussion of how skill standards are presently being used in postsecondary institutions. Findings from studies of three postsecondary professional education programs—Business Administration, Engineering, and Social Welfare—are provided to offer a promising model that can help inform states as they develop their own standards.

The report concludes with recommendations that federal and state policymakers and industry and education representatives may want to pursue in order to promote the use of skill standards to improve curriculum, instruction, and assessment. A synthesis of the literature on skill standards, detailed descriptions of state and local systems, and an explanation of the methodology used to conduct this study are included in an accompanying volume.

Overcoming Obstacles to the Use of Skill Standards in Education

The primary objective of any skill standards initiative should be to improve the content and instructional quality of education programs. Skill standards have been promoted as a way of motivating all students to learn by focusing their attention on the academic knowledge and skills they will need for success in the workplace, at home, and in their community. Beyond simply increasing the caliber of instruction, a skill standards system should help students select from a number of career and life pathways. Standards should introduce students to the range of educational options and careers available, and provide them with information on the type of academic and work force preparation they will need to find employment in the industry and occupation of their choice. At their most specific, industry standards can help students gain the advanced skills they will need to find immediate employment in the occupation of their choice.

Presently, state policymakers and industry groups are using a variety of frameworks to define skill standards. Inconsistencies in standards format and specificity and a lack of supporting materials for educators often mean that industry standards fail to readily translate from skill lists into classroom practice. Moreover, a lack of communication across states and an absence of practical models to guide development efforts have contributed to the following:

- Inconsistent state and national skill standards frameworks;
- Standards that specify low levels of academic skills; and a
- Lack of infrastructure to support using standards in curriculum and instruction.

This research suggests that skill standards are beginning to play an important role in education. Although the case study visits that the research team conducted were limited to four states, the results indicate that well-designed skill standards can have a positive impact on curriculum, instruction, and assessment. As such, while characteristics and conditions from these four states may not be generalizable to the entire nation, the lessons that they provide shed light on the challenges and constraints of using industry skill standards to strengthen education. The following section details some of the obstacles that educators presently face in using skill standards to support curriculum and instruction.

Inconsistent State and National Skill Standards Frameworks

The site visits indicated that states are using a variety of models to structure skill standards. As development proceeds, variation in standards specificity and organizing frameworks may yield a lack of consistency that could undermine national economic competitiveness, particularly if differences in state standards lead to instruction that fails to equip American workers with necessary marketplace skills. Perhaps more importantly, such differences may make it difficult for educators to share curricular and instructional materials that may improve classroom learning and support the development of portable skill certificates. Presently, state skill-standards drafting efforts are inconsistent, as evidenced by an absence of agreement on a common lexicon or cluster of industries to govern national discussions. These efforts also suffer from a dearth of exemplary models that states might consult when pursuing standards development.

Need for a common lexicon

Absence of a common language hinders the sharing of best practices because basic terms such as *skill standard, industry cluster*, and *occupation* often mean different things in different states. In some cases, these differences are merely semantic. For example, the state of New York uses the term *career major* to describe a wide range of industry areas that are characterized as an *industry cluster* in Oklahoma and Illinois. More serious miscommunication arises when states use similar terminology to describe standards that are radically different. For instance, Washington State uses the term *cluster* to describe a group of related occupations within a specific industry area, such as Secondary Wood Products, that would correspond to a much narrower industry/occupational cluster in other states.

The research team found that there was much confusion about terminology when conducting interviews at the local level. Meetings with teachers and institutional administrators typically required an opening discussion to clarify language and specify the meaning of particular skill standard terms. Indeed, in one comprehensive high school in Illinois, instructors initially questioned their own presence at the session because they did not view skill standards as part of their curriculum; it was only after the term was defined in the context of the school's use that teachers recognized standards as an essential component of their integrated program.

Variation in terminology is also contributing to the development of inconsistent national and state industry standards. To date, standards that have been defined vary in their breadth and specificity, meaning that industry skills often have little relationship across, and sometimes within, state lines. This lack of coordination can have serious consequences, particularly if

identified standards fail to offer students information about the levels of achievement necessary to pursue careers in their selected field. Differences in state frameworks may also make it more difficult for educators to share curricular materials or develop skill certificates that are recognized beyond their district or state.

In many respects, the lack of a common lexicon to describe state standards parallels the initial confusion that arose following the introduction of the National School-to-Work Opportunities Act. Although educators were encouraged to develop activities that connect students, schools, and workplaces, instructors lacked a basic understanding of the types of activities that fulfilled school-to-work objectives. To overcome this obstacle, the National School-to-Work Office published a glossary of commonly used terms that describe school-to-work programs. Developed through an intensely collaborative process involving state system builders and stakeholders in business and organized labor, the School-to-Work (STW) Glossary of Terms supports decentralized state and local efforts to create STW programs, while encouraging eventual convergence toward a national system. Since new terms are periodically added and illustrations and references are updated, the glossary is a working document that can change over time to reflect the contributions or comments of interested parties.

Variation in skill clusters

At the present time, each of the four case study states is actively grouping occupations into clusters that share related work characteristics. Clustering occupations can provide a stronger basis for integrating academic and industry skill standards than organizing standards around individual occupations, because clustering can assist teachers in applying knowledge and skills in a wide range of related work fields that span both the breadth and depth of an industry. Moreover, clustering can expand students' education and career options by helping them to see the academic and technical requirements for a number of entry-level and more advanced occupations. Depending upon how they are specified, industry clusters can also help students to understand the different types of professions that exist within a particular industry field.

While case study states were taking decidedly different approaches to developing industry clusters, there was still considerable overlap across industry sectors. Although fine distinctions do exist—for example, Illinois has defined a communications cluster that New York subsumes in Engineering/Technologies—there appears to be sufficient consensus to justify identifying an initial group of clusters that could serve as a foundation for national discussions. Indeed, the National Skill Standards Board has recently recognized three cluster areas—Manufacturing, Retail/Wholesale Sales and Services, and Business and Administration

Support Services—that will serve as a basis for initial national standards initiatives. It is anticipated that the Board will propose additional clusters over time, until a total of 16 economic sectors are identified that will span the entire economy.

In addition to federal and state efforts to define industry clusters, the National Board for Professional Teaching Standards recently released draft standards for National Board Certification of vocational educators. By identifying eight industry career specializations on which exemplary vocational teachers can focus, the Board ensured that each cluster encompasses a wide variety of career opportunities and experiences that could be readily transferred across cluster areas. For example, in addition to learning the specifics of food preparation in a culinary class, students could also learn about different aspects of running a restaurant, including planning, budgeting, and managing business operations (National Board for Professional Teaching Standards 1996).

National And State-Identified Industry Clusters

National Board for Professional Teaching Standards (8 clusters)	Illinois (14 clusters)	Oklahoma (6 clusters)	New York (6 clusters)	Washington (6clusters/ 12 proposed)
Agriculture and Environmental Science	Agriculture	Agriculture	Agriculture	Secondary wood uses Food processing
Arts and Communications	Communications		Arts/Humanities	
Business, Marketing, and Information Management	Business/ Information Financial Services Marketing Retail trade	Business Marketing	Business/ Information	Information technology
Family and Consumer Sciences	Education Services Transportation	Family/ Consumer		
Health Services	Health/Social Services	Health	Health	
Human Services	Energy and Utilities Hospitality Legal/Protective		Human/Public	
Manufacturing and Engineering Technology	Science/Engineering Manufacturing	Trade/Industrial Industrial	Engineering/ Technology	Electronics Manufacturing Machining
Technology Education				

Although broad industry sectors overlap among states, there is considerable variation in the types of occupations and specificity of skills subsumed within clusters. For example, in some states, such as Illinois and Oklahoma, standards are defined for a specific set of entry-level occupations within each broad industry area. In contrast, standards in the states of Washington and New York encompass all occupations in an industry or all industries within a broad cluster, respectively. Of the four case study states, New York has constructed perhaps the broadest set of clusters by grouping industries that share related substantive aspects.

To clarify the different approaches that states are taking to organize standards, consider, for example, an industry cluster in the Engineering/Technologies sector. In New York, this grouping might encompass a range of technical skills *common to some or all of the fields* that constitute an industrial sector. However, standards in Washington State might be more aptly called *career standards* since identified skills would apply to all occupations in the electronics industry. In Oklahoma and most recently in Illinois, *occupational standards for specific jobs*, such as avionics technician, have already been specified. This clustering across related occupations within an industry area, and then across related industries within an industry sector, is expected to eventually yield clusters that correspond to those specified in other states.

Electronics Clusters

Occupationally Specific Standards

Oklahoma — **Trade and Industrial Cluster: Electronics**

Specific standards spanning a range of occupations:

- General electronics technician
- Avionics technician
- Consumer products services
- Microcomputer systems technician
- Industrial electronics technician
- Telecommunications technician
- Electronic assembler
- Business machines technician
- Biomedical electronics technician
- Microcomputer systems field service
- Instrumentation technician
- Automotive electronics technician

Illinois — **Applied Science / Engineering Services Cluster**

Specific standards for occupations are under way.

Washington — **Electronics Cluster**

General standards spanning all careers in the electronics industry:

- Safety and health requirements
- Communication processes and procedures
- High-performance workplace skills
- Company- and market-specific knowledge
- Troubleshooting
- Materials and tools
- Test equipment
- Electronics skills

New York — **Engineering / Technologies Career Major**

General standards spanning a range of industries:

- Architecture
- Biomedical
- Civil
- Chemical
- Construction
- Communication
- Computer
- Electrical
- Electronics
- Industrial
- Laser
- Optical
- Manufacturing
- Mechanical
- Transit

Broad Industry Standards

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In states where occupationally specific skill standards systems were already in place, policymakers often had to overcome resistance to change from vocational educators. For example, attempts to consolidate occupational standards into a single set of cluster standards in Oklahoma received mixed reviews from teachers in occupational programs. Concern was particularly pronounced among teachers in some advanced technical fields, such as electronics, where one teacher feared that clustering could lead to "watered-down" curricula that failed to address specific industry skills. Given that the state has not expressed any intention of getting rid of its existing vocational task lists and is pursuing occupational clustering as a means of serving all students, not just those enrolled in vocational programs, it appears that such fears are to date unfounded.

Interviews with participating local business partners revealed that most firms were seeking workers with basic academic skills who could learn on the job and adapt to changing workplace conditions. For example, employers in Illinois related that they neither expected nor wanted schools to teach students highly technical, job-specific skills, either because they were concerned that increased specialization would reduce the emphasis on basic academics, or because it was unlikely that schools could provide the advanced, firm-specific skills that employers desired. While these expectations may not be held by all private-sector employers, it highlights the need for state standards-drafting committees to clarify the level of skill specificity, and by implication the level of industry clustering, that is desirable before beginning standards development.

Need for exemplary models

Each case study state has developed guidelines to describe the content and process for developing skill standards. Generally, the specificity of these directives varies according to the level of detail that states use in their occupational profiling. For example, Oklahoma, which has identified skill standards for more than 200 occupations, has developed a comprehensive *Duty/Task List Development Process* that specifies the manner in which occupations are identified within programs, broad areas of performance "duties" within each occupation, and specific activities or tasks associated with each duty. In contrast, Washington State, which has taken a more decentralized approach to standards drafting, has encouraged each standards project to develop its own organizing techniques. Interestingly, although state developers can devise their own approaches, most have adopted the strategy pioneered by the state's first skill standards project in manufacturing technology. Nearly all subsequent projects have followed a similar process for identifying and validating skills.

Skill standards identified by professional groups also provide some structure to state standards-drafting activities. Typically, representatives of state standards committees consulted a variety of standards—national industry pilot projects as well as professional associations—

before delineating state standards. In some cases, states adopted all or nearly all of the national pilot project standards with only minor changes. For example, the National Health Care standards were adopted almost in their entirety in New York and Oklahoma, as were the Machining standards in Illinois. Where national standards failed to meet state needs, sections were often adapted for state use. For instance, though one state administrator described the CADD standards as being too specific for his own state's needs, portions of the standards were incorporated when the state identified its own technology skill standards.

Although standards development within states is proceeding, absence of a common framework means that the content and format of standards continues to vary widely by state. Moreover, aspects of standards that could assist teachers—such as specifying how standards relate to academic and employability skills—vary widely. Ideally, an exemplary standard would offer examples of skills required to perform a specific duty or task, detail academic skills associated with the industry skill, provide possible scenarios or applications for the task, and outline performance assessments that could be used to determine students' level of skill acquisition.

Standards Specify Low Levels of Academic Skills

With few exceptions, standards developed by industry groups have focused on the skills required for career-entry positions. While these initial efforts have helped inform state and national efforts, often the academic skills associated with these entry-level positions are relatively modest. As such, they often underestimate the knowledge required for career development and advancement. If schools are to offer a foundation upon which students can build a career in one or more industries, then standards must have sufficient breadth and depth to support further education, as well as address the demands of more advanced and better paying work than students will initially find upon first entering the labor market—whether it be after high school or college.

Raising the standard

At a recent conference called *Integrating Academic and Occupational Skill Standards*, sponsored by the National Center for Research in Vocational Education, industry and academic educators met to assess relationships among national academic and industry standards pilot projects. At this conference, it was determined that higher level academic skills were often absent from industry-defined standards. For example, many national industry projects stressed basic academic skills, such as the ability to do arithmetic and multiplication, read materials written at the sixth- or eighth-grade levels, or write properly punctuated sentences.

Among the 22 national industry pilot projects, perhaps the most comprehensive effort to relate industry and academic standards has been the work performed by the National Automotive Technicians Education Foundation, Inc. (NATEF) of the National Institute for Automotive Excellence. Working with the Vocational–Technical Education Consortium of States (V-TECS), NATEF set out to revalidate existing duty/task lists and identify related academic skills in two automotive specialties—Automobile Collision Repair and Refinish and Medium/Heavy Truck Technician. In many aspects, this NATEF effort has been exemplary: the group has compiled a comprehensive list of specific academic skills as well as documented how they would be applied by the typical technician (Hoachlander 1996). For example, as part of its work, NATEF has identified a range of mathematics-related technical skills that include addition, subtraction, multiplication, and division; measurement of angles; use of charts, tables, and graphs; and computation involving metrics and geometric figures.

Selected Mathematics-Related Academic Skills

Collision Repair and Refinish Technician

The technician can perform the following tasks:

- Add whole numbers to accurately determine measurement conformance with the manufacturer's specifications;
- Mentally multiply numbers to determine conformance with manufacturer's specifications; and
- Distinguish whether or not the angle between related parts (e.g., body or suspension components) is within the manufacturer's specifications.

Source: National Automotive Technicians Education Foundation, 1995.

Although NATEF has done a remarkable job in capturing the academics required of an automotive technician, many of the skills it has identified are quite elementary. In the case of Collisions Repair and Refinish, the highest level of mathematics required for occupational success appears to be at the eighth-grade level.

While Autobody Technicians may need only minimal mathematical skills to be successful in their field, the low levels of academic competencies associated with the occupation can be problematic. Although academic teachers can use NATEF-identified skills to develop integrated curricula, the low skill levels associated with the profession may limit the use of these skills to the middle school grades. While it might be possible to find more advanced, higher level academic skills—such as calculus or physics—within the occupation, forcing artificial connections may be counterproductive, particularly if one intends to use industry skills to offer applied instructional opportunities.

Defining broad industry clusters—such as transportation—can help overcome the obstacles posed by low-skill occupations by offering teachers access to a range of careers that require different skill sets. To ensure that teachers have a variety of skills from which to draw, and that students are exposed to a wide range of career experiences, it may be most practical for standards to be developed for entry-level as well as more advanced occupations. Unless high-level academic skills can be associated with a number of industry occupations, occupationally specific skill standards may have little application outside of traditional vocational classrooms and, as such, will appeal to only a fraction of teachers and students.

Lack of Infrastructure for Curriculum and Instruction

To date, skill standards development has often addressed specific industry skills associated with career-entry positions. While profiling duties and tasks for discrete occupations may be a necessary first step in building a skill standards system, the case study visits suggest that few educators have the technical background to deploy industry-specific skills in the classroom. Specifically, academic teachers often lack the occupational knowledge to link their subject area disciplines to industry applications, while vocational instructors often lack the academic training to connect their industry skills with academic subjects. If standards are to be successfully introduced into all classrooms, then teachers must be able to crosswalk industry and academic skills, and have ready access to examples of exemplary curricular materials and assessments so that they can design their own tasks and assessments.

Successfully infusing industry skill standards into education requires creating an instructional infrastructure that academic and vocational teachers can access when developing classroom curricula. Academic teachers often teach their subject area disciplines without reference to the workplace, in part because textbooks and other instructional resources often pay little or no attention to the relationship between schooling and work. Conversely, while vocational teachers may understand the specific industry applications of selected skills, many such instructors lack the understanding to make connections between industry and academic concepts, or they do not see it as a significant part of their larger responsibilities. In both cases, the initial professional education of teachers requires a serious overhaul.

The challenge of weaving industry skills into academic curricula was perhaps best articulated by an Algebra I teacher participating in a machining pilot project in Illinois. Faced with the task of incorporating the National Machining Industry Standards into his math instruction, he initially struggled to relate the subject area content he knew well to industry applications in a field he knew nothing about. Although he confided that the process was initially disheartening, he reported that it was not until he spent a summer working at a machining firm that he was able to make clear connections between the mathematics topics he typically taught

with the skills defined by industry. Unfortunately, not all teachers can arrange such intensive field placements. Even when a teacher understands a specific industry area well enough to take advantage of industry-defined standards, it is unlikely that the instructor would have sufficient background in several related fields (e.g., aerospace, maritime, rail) to make broad connections between academic and industry applications that span the cluster.

> ***Before skill standards I never knew what to say when students asked me, "why do I need to know this?" Now I finally have an answer that I believe: You need to know this because once you get a job, this is how you will use it.***
>
> ***—Kathy Arruda, Math Instructor***
> ***Streamwood High School, Elgin, IL***

Without some type of crosswalk that links academic concepts to specific industry skills, most teachers were hard pressed to find linkages between industry standards and their traditional academic curriculum. Consulting such a skill crosswalk might not be much different from using a Spanish-to-English dictionary: one could look up a specific academic concept, such as factoring, and find a number of related industry applications that are essential for career success. Furthermore, if this skill crosswalk were in the form of a relational database, such as those now being developed in Washington State, one could imagine an instructor electronically entering an academic concept into a computer to identify six or seven specific industry applications that would provide a context for instruction.

Some groups have already initiated such work. For example, the Machine Tool Advanced Skills Technology (MAST) program is a multi-state consortium of community colleges, funded by the U.S. Department of Education, Office of Vocational and Adult Education, that is now developing industry-specific skill standards and model curricula for 15 occupational specialty areas within the machine tool and metals-related industries. Detailed crosswalks assist educators in relating academic and general work force readiness skills, identified by the Secretary's Commission on Achieving Necessary Skills (SCANS), with specific machining applications. Using the MAST list, a vocational teacher might select academic skills to incorporate into the computer curriculum, or an academic teacher might seek computer applications that provide a context for class instruction.

However, not all industry standards need translate into specific academic skills. For example, in the sciences, there may be situations where a biology teacher might choose to inform students about a specific academic subject, such as the nucleus in a cell, rather than trying to force the subject into an industry application, such as the management and administration of a business firm. Ideally, skill crosswalks will enable teachers to make logical connections between academic and industry subject areas that have overlapping domains of knowledge and skills.

MAST: Crosswalking Academic and Industry Skills

Selected SCANS Skill	Related Industry Skill
Basic Skill: Arithmetic/Mathematics Performs basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques.	- determines optimum machining speeds, feeds, and depth of cut - interconverts fractions to decimals - identifies machining points using the Cartesian coordinate system
Thinking Skill: Problem Solving Recognizes problems and devises and implements plan of action.	- makes daily accommodations to stay on schedule - seeks additional instruction/clarification for assignment completion - troubleshoots and debugs CNC programs
Personal Quality: Self-Management Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control.	- performs in-process quality checks on machined machined parts - maintains a record of academic progress - accepts responsibility for mistakes and infractions, and takes steps to resolve them

Source: Machine Tool Advanced Skills Technology Program, 1996.

A relevant question is who should take responsibility for crosswalking industry with academic standards. Initially, identifying separate academic and industry standards, and then finding common areas of overlap may be the simplest solution. This will mean that industry has to clearly define terminology, outline essential components of the industry, and provide examples of how academics are used in performing the task. Alternatively, it may be more efficient to have educators and industry groups work together to link industry and academic standards at the time they are developed.

Need for inventories of instructional applications

In each case study site, industry standards developed by state working groups often failed to specify associated academic skills, partly because standards materials were written by industry practitioners for use by industry professionals. Even in states that were using standards that included skill crosswalks—such as Illinois and Oklahoma, which adopted the NATEF automotive standards—crosswalks were most often used by vocational teachers to introduce academic skills into their classes. Communication between vocational and academic teachers, which could possibly have helped to clear up this confusion, was often hampered because of physical barriers. In Illinois, for example, industry instruction was offered in a separate regional vocational center to which students were bused from their comprehensive high school.

While skill crosswalks can help academic educators find discrete applications for specific skills, existing crosswalks are often not sufficient for academic educators to bring industry skills into their classrooms. In each case study site, academic educators claimed that they had little understanding of how their subject matter might relate to industry applications. To tackle this issue, some industry groups have attempted to develop materials that can assist instructors in designing their own course materials. For example, the Bioscience national industry skill standards project developed a set of scenarios in which industry skills were presented in a workplace context. Each scenario illustrated a typical workplace situation and a likely unanticipated problem that was intended to engage students in decision making and problem solving. Although the Bioscience standards focus primarily on skill standards associated with entry-level Bioscience technicians, the scenario approach may ultimately provide a useful way of linking academic and industry skills.

Perceiving that it is virtually impossible to develop materials to meet the needs of every classroom instructor, several states are designing statewide curricular networks to provide instructors with on-line access to state-recognized standards. For instance, the Manufacturing Technology Advisory Group (MTAG) in Washington State has created software applications that enable teachers to crosswalk skill competencies with exemplary lesson plans. Instructors first select a skill competency that they want to teach, and then use an electronic database to obtain information regarding classroom supplies and equipment, instructional methods and exercises, evaluation techniques, and the address and phone number of the teacher who wrote the lesson plan. To take advantage of electronic dissemination, the MTAG advisory group is also planning a World Wide Web site that will provide state-level information for local educators, and enable teachers throughout the state to share exemplary practices and discuss obstacles to using skill standards. Eventually, students will also be able to tap into a data bank where they may download assignments and exams and practice their knowledge of standards.

Like Washington, a number of other states are planning to use new technologies to disseminate skill standards and provide technical assistance to educators who use them. For instance, Oklahoma is planning to modularize and digitize existing standards and curricular products, while New York is considering a statewide staff development and curriculum network. Underlying these efforts is an understanding that in addition to having copies of the standards, educators must have access to resources and support for using standards if they are to successfully translate them into practice. Building an electronic network is a cost-effective way of rapidly disseminating information to a large audience.

Electronic dissemination of standards information for curriculum planning and development promises to improve states' access to information and increase communication about skill standards. Most importantly, it will enable instructors to tighten the link between

standards and curriculum, thereby making instruction more relevant for students. Electronic media can provide instructors, students, and employers with immediate access to current skill standards; can assist instructors in linking industry standards with academic curricula; and can promote statewide sharing of exemplary curricular materials, assessments, and instructional practices. Like any new technology, the primary drawback of these systems is their expense: the substantial capital costs and staff time associated with developing and maintaining electronic databases may be prohibitive for some states. In an environment of ever-tightening education budgets, administrators may not be able to purchase computer hardware, much less afford to train teachers and counselors on how to use it.

> ***The way to summarize...standards is that they are a set of targets that industry has specified as important for educators to aim our curriculum. Those are the targets and we are in the business of building arrows to shoot at those targets.***
>
> ***— Dr. Tom Phillips, Instructor***
> ***South Seattle Community College,***
> ***Seattle, WA***

Essential Practices

Skill standards are a new, important component of the nationwide effort to improve American education. The expectation is that industry standards can increase student achievement by offering a real-world context for teaching academic and vocational knowledge and skills. Along with motivating students to learn, industry standards that reflect contemporary industry practices can outfit students with skills that will enable them to function in an evolving, increasingly more sophisticated workplace. However, if standards are to serve all students, including those planning to attend college before they enter the work force, then standards must address a broad range of basic and advanced industry skills that enable students to fully explore their postsecondary education and career options. Perhaps more importantly, educators must be able to use identified skill standards to reinforce their instruction and improve how they measure student learning.

Nearly all state skill standards projects, regardless of their scope or intended target, share a number of basic characteristics. The following section details essential practices that state policymakers and secondary and postsecondary educators are currently using to promote, organize, and measure skill standards for education. These practices include strategies to promote statewide support for standards development among private-sector employers and educators, and techniques to align industry standards with curriculum and assessment. Taken together, these practices account for many of the issues that state and local policymakers face when developing industry skill standards for use in education.

Although each case study site grappled with issues related to standards development, not all adopted similar strategies to address them. Moreover, while each of the practices described below can contribute to the eventual use of industry standards in education, the scope and specificity with which skills are identified may ultimately determine how suitable they are for work force development and classroom instruction. The following discussion reviews the differing approaches that state policymakers have used to design standards, and describes the trade-offs of approaching development from an industry or education perspective.

Building Statewide Support for Standards Development

Standards must satisfy multiple audiences if they are to promote work force readiness and provide a basis for instruction. On the one hand, standards must be somewhat related to actual industry practices if they are to help students understand the skills they will need to secure future employment. This means that private-sector representatives must assume an active role in defining the skills that relate to a wide range of career opportunities. Skill specificity must be balanced, on the other hand, to enable educators to use identified standards to enhance their teaching of academic and vocational subjects. Moreover, this suggests that teachers must be somewhat flexible about how they integrate standards with curriculum and instruction to ensure that standards do not narrow students' career and postsecondary education options. The following section describes strategies that the case study sites have designed to involve educators and individuals from the private sector in standards design.

Private-sector involvement

Private-sector participation can inject a much needed real-world perspective into industry skill standards. In fact, the case study sites reported that participants from business, industry, and labor contributed not only to the design of broad skill frameworks but also to the benchmarking of skills to current marketplace practices. Private-sector representatives who participated in standards drafting enthusiastically endorsed their state's efforts by committing significant human and fiscal resources to system development. Additionally, in all four states, industry members worked with state policymakers to identify current workplace needs, validate identified skills, and provide information on work force trends.

Finding allies in the private sector has also helped sustain state skill standards-drafting efforts. Public support for standards is presently weak in a number of case study sites, in part because of a perception that standards threaten unwarranted government intrusion. However, endorsement from the business community has helped legitimize standards development in some states by focusing attention on how standards would benefit the state economy. Moreover, industry involvement helped ensure that standards development moved forward even in the face of unstable financial resources. This was most apparent in Illinois, where private-sector representatives who were serving on state skill standards committees enthusiastically reported that their efforts would continue even if state funding were to be discontinued.

In working toward the goal of improving students' educational opportunities, standards developers have overcome many potential obstacles. For example, conflicts between employers and labor, and turf battles among competing industry groups, failed to materialize because representatives were willing to set aside their professional differences. This "clearing of the air"

occurred because high-level industry and union officials supported standards development, and because members of the private sector recognized that skill standards could ultimately improve students' education and work force preparation. Without the support of industry, many state policymakers suggested that the development of such standards would have had little chance of success.

In states where skill standards tended to be highly job specific, such as Illinois and Oklahoma, standards-drafting committees were often comprised of a number of industry-recognized experts drawn or nominated from the field. These representatives generally focused on technical skill requirements for occupations, such as practical nurse or carpenter, that students would need for entering a career. Similarly, in Washington State representatives from the field were recruited to develop industry standards; however, these standards-drafting committees focused on identifying a broad set of skills that could apply to all careers within a specific industry area, such as Machining. In contrast, in New York, a select group of industry executives and union leaders worked with state policymakers to designate career majors spanning a broad industry sector that would provide a context for students' academic studies.

> ***The magic of this effort is the overwhelming business involvement and support—from the largest associations to the smallest companies.***
>
> ***—Bill Herman, Business Advisory Member***
> ***Bridgeport Machines, Inc., Aurora, IL***

As the employer of trained workers, the private sector has some incentive to focus skill standards around relatively narrow career-entry positions for which it is often difficult to recruit qualified workers. While defining industry skills associated with specific jobs may assist employers in identifying trained workers, standards that are too narrowly specified may inhibit educators from integrating standards into curricula that expand students' education and career opportunities. Moreover, since industry participants generally have limited training in curriculum development, or may fail to see how industry and academic skills are linked, it may be unrealistic to expect employers to identify broad standards that all teachers could adopt. To overcome this obstacle, states such as Illinois and Oklahoma are planning to review occupationally specific standards in order to cluster occupations into broad industry areas that share related skills. This promises to be a lengthy process. For although standards projects in Illinois have been in place for more than two years, only a handful of occupations or specific industry clusters have as yet been defined. Moreover, even in Oklahoma, which has more than 200 existing occupational standards, skills generalization across occupations has not occurred.

When state education administrators have taken a more active role in defining standards, such as in New York where private-sector involvement has been limited to corporate executives and union leadership, standards have tended to relate to more generic industry applications. While broader definition of skill standards can offer students a greater understanding of career opportunities, this can hamper teachers' use of standards if skills are defined at too high a level to provide real-world applications. To address this issue, state policymakers in New York have convened Career Major Panels to refine the industry skills necessary for employment in each career area. However, since their skill definition will focus on the entire broad cluster, rather than on specific occupations in the field, it is not clear how this will affect students who are interested in pursuing advanced career studies.

Flexibility for educators

Over the years, secondary and postsecondary educators have worked with business partners to develop vocational curricula that reflect local and, in some cases, state and national marketplace needs. For example, industry advisory boards are often consulted to review coursework and to make recommendations that will bring classroom instruction in line with actual industry practices. In the absence of formal advisory groups, educators at the secondary and postsecondary levels often work with local employers to draft course materials and occasionally to contract with specific firms in order to offer customized training. In either case, skills that are clearly articulated by local employers enable students to put their training to immediate use in the business community.

To accommodate teachers' instructional needs, states are providing educators with some discretion in using industry standards. Although educators are not permitted to alter or delete state-defined skills, instructors may often supplement or add their own local benchmarks to exceed statewide measures. Typically, these changes are intended to bring district curricula in line with those suggested by local advisory board members, or to more closely reflect the economic circumstances of the local business community. For example, Oklahoma has developed duty/task lists (DTLs) that stipulate the skills secondary students need to be certified in specific career-entry positions. In order to develop task lists, states examine standards developed by national professional associations and consider input from a broad range of private-sector employers statewide. Moreover, to assure system flexibility, local advisory committees typically revalidate state-identified skills, thereby ensuring that standards encompass the full range of skills in the occupation. In cases where regional skills are ignored, local advisory groups may stipulate additional standards to redress missing content.

Adding Local Flavor to State Skill Standards

In Washington State, the community and technical college system has taken the lead in developing industry skill standards. The state selects institutions with particular industry specializations to develop skill standards that are eventually adopted by all postsecondary institutions. To ensure flexibility, the state has explicitly recognized the need for educators to tailor standards to meet local needs. Local community and technical college faculty, in cooperation with area business, industry, and labor representatives, may create their own standards to supplement statewide technical and foundation skills.

State officials in New York have ceded local educators considerable flexibility in sequencing industry standards. A set of seven voluntary curricular frameworks outline the state's academic and occupational standards, and serve as a guide for elementary and secondary educators developing K–12 curricula. Although the state frameworks group competencies into elementary, intermediate, and commencement skills, local developers may assign their own grade levels to the standards. To illustrate, the New York City Board of Education has used the state frameworks to help develop its curricular standards and, in doing so, has organized them by individual grade levels ranging from pre-K to grade 12.

The ability of local educators to tailor skill standards to meet community needs may ultimately influence the fate of state and national standards. The present climate probably cannot support a single set of national standards, and in some jurisdictions, these concerns carry over to the state level as well. District involvement in validating and developing skill standards can encourage local ownership, and may increase the likelihood that teachers will incorporate state-recognized standards into their classroom practices. While flexibility can temper state control of local curricula, it can also introduce several problems, particularly if school administrators become too focused on the local labor market and overlook broader opportunities for student learning.

In an era where the schools should be providing young people with the knowledge, skills, and mental discipline necessary to command a decent wage in an evolving labor market, a narrow focus on local job opportunities can be counterproductive. In fact, there are local school districts that, recognizing the meager job prospects for young people in their communities, quite deliberately attempt to provide an education that will make students highly employable elsewhere.

Aligning Curriculum and Assessment

Skill standards can help increase linkages between curriculum and assessment. First, using standards to align curriculum and assessments in turn creates more relevant assessments in which students are tested on the skills required for employment and further education. Second, when student assessments are closely linked with standards and curricular materials, both written and performance assessments provide a form of instructional accountability for teachers, schools, districts, and state leaders, as well as a benchmark of quality for employers. Third, creating strong linkages between state or nationally developed standards, curriculum, and assessments also ensures some uniformity in statewide instruction. Such standardization can provide students with recognized, portable credentials, while offering industry a more qualified work force. The following section details essential practices that states are using to strengthen the connection between the academic and industry skills that students are taught and the way in which they are held accountable for this knowledge.

Using standards to organize instruction

Curriculum aligned with recognized industry standards can assist teachers in structuring their instructional practices. Uniformity in skill requirements, when coupled with well-designed testing regimes, can also help students gain portable, industry-recognized skills that can increase their career opportunities. For example, in Oklahoma, occupational DTLs provide a detailed blueprint for curriculum development that educators can use when designing classroom exercises. Since the DTLs also include frequency and criticality indices for each task, the curriculum is used to guide question writers in developing statewide certification tests for specific occupations. Students successfully completing a DTL are awarded a standardized, state certificate that state employers recognize regardless of where a student received his or her actual instruction. Presently, DTLs focus on the specific job level; although the state has defined occupational clusters within industry areas, no corresponding certification presently exists.

Oklahoma

Industry: Trade/Industrial
Industry/Occupational Cluster: Machine Tools
Occupation: Power Saw Operator

Selected Standards: Perform Benchwork

A.01	Deburr holes and sharp edges —files, scrapers, coated abrasives, deburr knives
A.02	Tap holes—go/no go gauge, cutting fluids
A.03	Install press-fit bushings—desired fit, arbor press
A.04	Layout job—layout ink, scribe, surface gauge, layout height gauge, ball peen hammer
A.05	Read blueprints—orthographic views, isometric views, tolerancing, ISO projections

While Oklahoma's standards have strengthened specific occupational instruction, New York has used skill standards to develop broad, overarching curriculum frameworks to aid local educators in crafting curricula. These voluntary curricular guidelines emphasize applied academic and career skills for all students. Again, the link between the frameworks and assessment is skill standards. Recently, the state has unified its Regents diploma system based on the requirement that every New York student must achieve the same stringent academic and career competencies to graduate. The state's proposed new Regents exam will be closely linked to the competencies in the academic subject frameworks and, like the frameworks themselves, will eventually incorporate local input. This will be accomplished by soliciting feedback from parents, teachers, and members of the business/industry community. Rather than producing a single Regents assessment each year, the State Education Department may develop a large bank of test items that local educators can access when designing their own exams. The extent to which the Regents exams will address specific career major clusters has yet to be determined.

New York

Industry: Engineering/Technologies
Industry/Occupational Cluster:
(selected industries)

- Architecture
- Biomedical
- Civil
- Chemical
- Construction
- Communication
- Computer
- Electrical
- Electronics
- Industrial
- Laser
- Optical
- Manufacturing
- Mechanical
- Transit

Selected Standards: Specialized and Experiential Levels

- Read and interpret technical manuals to determine location of an automotive electrical fault
- Apply complex computational procedures necessary for managing a construction worksite
- Construct manufacturing design diagrams using CADD equipment in a work setting
- Write a report on safety procedures regarding disposal of hazardous waste on the worksite

Linking curriculum and assessment

Although states will continue to rely on traditional testing procedures to evaluate student competencies, the new connections between standards and curriculum are also serving to promote assessment through performance evaluations. For example, Washington State has specified competencies in broad industry cluster areas—such as manufacturing technology—that are linked to measurable performance objectives that industry and labor expect all students to fulfill. Emphasis is placed on students' hands-on performance on tests that assess their problem-solving skills, ability to locate and synthesize information, and capac-

ity to make inferences. However, actual test design and scoring of student performance is decided by individual teachers at local schools, who are not held to objective state measures in assessing student learning. In other words, there are no state-approved benchmarks to guide ratings by teachers across the state.

Washington State

Industry: Manufacturing
Industry/Occupational Cluster: Manufacturing
Shop Skills: Understand how tools and fixtures are used in manufacturing

F3.1. Determine replacement and retooling requirements for a variety of machines
Performance Objective: Given five lathe cutting tools, five drill bits and five saw blades, appropriate gauges, and an opportunity to use or otherwise inspect these tools, the student will be able to correctly determine the needs or replace or retool each based on speed, cutting characteristics, and instructor criteria.

F3.2. Describe the importance of correct fixtures
Performance Objective: Given particular machining (or assembly or welding) operations, the student will be able to identify the correct fixtures to be used (such as a depth gauge on a drill press), and verbally explain their importance.

F3.3. Design and create fixtures
Performance Objective: Given part specifications, the need to monitor the amount of pressure on the part during its machining, and provided clamps and required gauge, the student will be able to design a fixture to perform a specified function and effectively use it to meet part specifications.

Similarly, Illinois is planning to use two formal assessments, or "gateways," to measure skill attainment in secondary education. The first would measure the academic and workplace skills of 10th-grade students in order to document their ability to focus on an industry cluster in their last two years of high school. At the end of grade 12, students would be retested to assess the more advanced academic and industry-specific skills they have gained through occupational coursework. This second "gateway" will help graduates show prospective employers or training institutions throughout the state that they have mastered the skills needed to enter the work force or to begin advanced education and training. Although Illinois does not call these assessments "Certificates of Initial Mastery" or "Certificates of Advanced Mastery," officials recognize that they are similar to such certificates offered in other states.

Because well-constructed industry skill standards encourage students to produce tangible displays of their learning, educators in several states are promoting the concept of career portfolios. Although portfolios can take many forms, they typically include a summary of

the students' academic qualifications, work experience and awards, and samples of exemplary work. The New York Board of Regents is considering adding a model state portfolio to its assessment of secondary students in order to better measure student learning. In Oklahoma, portfolios will be student-managed collections that highlight their skills for prospective employers; alternatively, in Washington State, educators are considering the feasibility of providing students with a "competency disk," or electronic copy of their mastered skills, to show to prospective employers. Whether employers will actually use these data to make hiring decisions is yet to be determined.

The specificity with which skills are defined and the manner in which they are assessed will most likely determine how private-sector firms use these measures. Skills that are narrowly defined around particular occupations may have the greatest appeal to employers, particularly if they reduce the need for employer-provided training or demonstrate students' productivity and specific labor market skills. More general assessments that measure work-readiness or industry cluster skills may also be attractive to employers who have created flexible work organizations, or who seek multi-skilled individuals capable of being trained for firm-specific jobs.

It is less clear how employers will respond to education skill certificates documenting student knowledge in broad industry sectors, or signaling that a student has mastered academic material in the context of an industry specialization. Presently, few employers consult students' education transcripts when making hiring decisions, partly because they do not believe that the grades reported accurately reflect students' level of academic achievement. It is not obvious, however, that portfolios and performance assessments developed by teachers will meet employers' information needs, or will better capture students' academic knowledge or work-readiness skills.

Skill Standards in the Professions

Although skill standards are most often associated with the trades or occupations requiring a subbaccalaureate degree, many postsecondary education programs rely on them to prepare students for entry to the professions. This section reviews the use of standards in postsecondary professional education programs in order to offer a promising model of how industry skill standards can be incorporated into teaching and learning. This discussion is based on the belief that too often industry skill standards developed by national and state groups are based on a flawed conception of how education for work should be structured at the secondary and postsecondary levels. This misunderstanding reflects a fundamental tension between standards intended to train workers for labor market entry and standards designed to prepare students for postsecondary education and career success. At issue here is the question of skill specificity—of finding an appropriate breadth of industry exposure and depth of occupational skills that can assist teachers in making academic knowledge and skills more concrete, while at the same time helping students to gain useful workplace skills.

Within professional education programs, standards often provide structure and definition to an area of specialization claimed by the occupation, as well as detail the knowledge and competencies required by those who call themselves professionals. An examination of how standards are used in undergraduate engineering and graduate social work and business programs reveals that curriculum in four-year colleges and universities is typically derived from two primary sources: professional accreditation agencies, which set core curricular standards, and faculty committees, which develop coursework that meets or exceeds accreditation standards. Although there are important differences in how standards are used for curriculum development in secondary and professional education, the structure and content of professional education programs, the involvement of faculty in developing and revising curriculum, and a reliance on alternative assessment techniques all provide useful lessons for federal and state policymakers seeking to establish "standards" for private-sector standards-drafting efforts.

Standards determine program format

Accreditation bodies composed of industry experts set minimum standards required of all professional programs. Most often, these criteria address subject area curricula and programmatic resources including administration, faculty, and facilities. Although curricular standards set by professional accrediting organizations differ in their level of specificity, most are program-level standards that provide a general framework for course content. Program standards are updated with the help of industry representatives and professionals who participate in set-

ting and validating accreditation standards to ensure that instruction keeps pace with current industry practices and knowledge. Standards influence the structure and content of a program's curriculum in three important ways: they ensure that the curriculum is progressive in structure, that the content promotes a global perspective of the profession, and that instruction emphasizes integrating theoretical and applied learning.

To address the progressive nature of knowledge acquisition, most postsecondary programs stress a foundation of general professional knowledge during the initial years of a student's training. Later years are devoted to building specialization in an area of interest. The accreditation standards for most professions define and promote this structure. For instance, the American Assembly of Collegiate Schools of Business requires that the Master's of Business Administration (MBA) curricula include a minimum of 18 semester hours of instruction in four core areas: financial reporting, analysis, and markets; domestic and global economic environments and organizations; creation and distribution of goods and services; and human behavior in organizations. Students take an additional 12 credit hours in their chosen area of specialization, and 18 distributional requirements outside their area of specialization.

Accreditation standards promote a comprehensive understanding of the profession by requiring that curricular content address problem solving and ethical issues, as well as help to develop a student's understanding of the role of the profession within society. For example, the core general engineering curricular standards of the Accreditation Board for Engineering Technology (ABET) ensure that students develop the capacity to apply relevant knowledge to the professional practice of engineering. In addition to a foundation of mathematics and science, relevant knowledge also includes the equivalent of one and one-half years of study in the humanities and social sciences.

Along with emphasizing a broad perspective, the curricular standards for both the engineering and social work professions also stress applied learning. For example, the Council on Social Work Education (CSWE) requires that all master's degree candidates complete 900 hours of structured fieldwork that is designed to help students apply theoretical knowledge in a real-world setting. In addition to working with a fieldwork supervisor, who monitors students' professional development, students also attend graduate seminars that help them to integrate their fieldwork experience with foundation social work skills. Similarly, the ABET divides engineering topics into two elements: engineering science and engineering design. Engineering science include topics that bridge mathematics, basic science, and engineering practice, while engineering design allows students to apply fundamental knowledge toward solving a practical problem.

The progressive structure, the global perspective, and the integrated content of professional curriculum promoted by accreditation standards offer three important lessons for using stan-

dards in secondary and subbaccalaureate education. First, the sequencing of broad foundation skills and knowledge, followed by progressively more specialized coursework, is a common characteristic of professional programs. Similar to a Certificate of Initial Mastery, foundation courses can help ensure that all students master a core of general knowledge, while specializations enable students to pursue in-depth studies in a specific area of interest.

Secondly, the comprehensive approach to knowledge promoted by professional standards fits well with the skill demands of the emerging high-performance workplace. Industry is increasingly seeking multi-skilled workers who can perform a variety of tasks. To meet industry's needs, skill standards in the professions acknowledge the importance of broad professional skills that promote students' understanding of the legal, social, economic and ethical implications of work. Finally, the professional model provides a strong argument for teaching academics within an applied context. Standards that are used in the professions make learning more realistic and relevant, and thus are preferable to current instructional regimes that are divorced from real-world applications.

Faculty involvement in curricular design

While representatives of most national industry pilot projects have attempted to provide applications for industry skills, in the professions it is educators themselves who are responsible for developing classroom curricula. Site visits to professional schools indicate that postsecondary faculty use their substantive expertise to develop occupationally relevant, yet academically rich, curricula, to reflect the structure and content of a professional field. Rather than turn to a prepackaged curriculum, which often lacks legitimacy among postsecondary faculty, the professional models suggest entrusting curriculum development to those who are expected to teach it.

To design curriculum, faculty use various methods to keep abreast of changes within the field, including conducting research, consulting with employers, hiring adjunct lecturers, and coordinating work-based learning opportunities. The competitive nature of grants requires that institutional research address current problems or professional needs, meaning that many postsecondary educators are at the forefront of their field. Consulting serves as a second form of contact between faculty and industry members. For instance, the University of California system encourages its instructors to use one day per week for consulting activities. To better meet clients' needs, faculty must maintain contact with their field of expertise and gain exposure to emerging technologies and other issues.

Although more often found in graduate than undergraduate programs, adjunct lecturers offer a third method by which programs keep curriculum and standards current. Adjunct faculty are usually practicing professionals hired to share experiences or to teach courses in special-

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ized areas outside the scope of expertise of full-time faculty. Lastly, involvement in applied learning programs offers faculty an opportunity to critically examine the current state of the industry field in which they teach. In social work, fieldwork consultants, who place, monitor, and advise students in the workplace, also assess the needs of industry; in business and engineering programs, internship and cooperative education placements provide a channel for educators and employers to communicate.

As experts in their field, postsecondary faculty are well equipped with the necessary industry and academic knowledge to engage in course design. It is unlikely, however, that most secondary instructors could develop course materials that integrate academic and industry skills without extensive professional development. Moreover, it is not clear that all teachers would be interested in designing their own curricula, or would have the technical skills to take full advantage of the opportunities that an industry approach can offer. Contextualized learning projects and scenarios, as well as models of alternative assessment and certification instruments borrowed from the professions, could provide a framework for curricular developers to design instructional materials. Additionally, both increased contact between industry and secondary school faculty and opportunities for industry placements could assist instructors in tailoring applications to local private-sector practices. Inviting industry personnel to serve as adjunct faculty at secondary and postsecondary institutions and exploring the use of structured work-based placements could also increase instructional relevance.

Emphasis on performance assessment

While most professions rely on pencil-and-paper assessments of core foundation knowledge, alternative techniques, such as performance assessments and team projects, are becoming more widely used. For example, in social work, fieldwork supervisors evaluate students' performance in their work placements to ensure their mastery of key skills and knowledge. In engineering programs, the capstone design project serves to demonstrate a student's ability to integrate the fundamentals of engineering with a specialized area of interest. The use of performance-based assessment also extends to professional licensure and certification. Specializations within engineering and social work that directly address public health and safety issues are subject to state licensing, where individuals must not only prove a minimum degree of professional competency on a written exam but also successfully complete an extended period of supervised practice. For example, engineering candidates must complete a bachelor's degree from an accredited institution and then complete two years of successful work experience.

Before candidates may begin banking supervised hours toward formal licensure, both the social work and engineering professions require individuals to first obtain a title of "in training" or "associate." This involves documenting that they have completed an accredited pro-

gram, and in the case of engineering, that they have passed a written exam. Once their supervised training has successfully been completed, candidates for both professions sit for licensure exams that, although administered at the state level, are actually developed by national associations. In addition to written exams, candidates must also pass an oral exam in some states; for instance, in California the Licensed Clinical Social Worker assessment protocol also includes an oral component. In determining students' capacity for work by assessing both their knowledge and practice, these professions are attempting to ensure that competent and experienced professionals will be working in their field.

Policymakers may benefit from reviewing performance-based assessment and certification models developed for use in professional education programs. Standards-based assessments, which enable students to demonstrate academic content using industry-recognized skills, can motivate students to learn by helping them understand how their classroom instruction relates to real-world applications. In addition to making learning more meaningful, standards and certificates linked to industry-identified skills can assist students in acquiring the general abilities that employers seek among entry-level workers. As in professional education programs, industry certification linked to advanced skill levels may sometimes be appropriate for secondary and postsecondary students seeking to specialize in a narrow occupational field.

Recommendations

To date, most state and national efforts to draft industry skill standards have emphasized the specific entry-level technical skills required for workplace success. While understanding occupational requirements can help students make more informed education and career decisions, industry standards must ultimately connect with academic curricula, instruction, and assessment if they are to fully benefit teachers and students. To further this goal, this report has outlined essential practices that, taken together, account for many of the issues that standards developers must address if skill standards are to positively affect schools. However, the use of skill standards in education is complicated by a number of inconsistencies in standard format and specificity, as well as a lack of instructional materials that educators may consult when planning classroom curricula. The following section outlines a set of recommendations that federal and state policymakers, private-sector employers, and educators can follow to build national consensus and coordinate ongoing state efforts to develop industry skill standards.

National discussions have tended to focus on what is the best approach for grouping standards (for example, by industry or occupational skills) and how to structure a system for national use. While maintaining this dialogue is important, it is imperative that a variety of strategies be developed to assist teachers and administrators in overcoming the obstacles to using industry skill standards in classrooms. In order to select a framework to guide standards drafting activities, state and national policymakers must understand the fundamental tension that exists between narrowly defined skill standards to promote work force training and broadly conceived standards to promote student mastery of academic knowledge and skills.

> ***The vocation acts as both magnet to attract and as glue to hold. Such organization of knowledge is vital, because it has reference to needs; it is so expressed and readjusted in action that it never becomes stagnant. No classification, no selection and arrangements of facts, which is consciously worked out for purely abstract ends, can even compare in solidity or effectiveness with that knit under the stress of an occupation.***
>
> ***—John Dewey 1916***
> ***Democracy and Education***

In many states, efforts to define state and national industry standards focus on defining the specific skills required for entry-level jobs. Once a sufficient number of job areas are defined, the intent is to develop clusters across occupations in order to identify the broad skills that educators can use to structure classroom instruction. Other states are attempting to define

broad industrywide clusters that encompass a number of related industries and occupations. At the present time, there is no way to determine whether either approach offers any particular advantage; it may even be possible that both approaches must be used to make a comprehensive standards system viable.

To promote development of consistent industry standards, the federal government may want to assume primary responsibility for building statewide consensus around uniform national skill standards. While there are good reasons for states to define standards that reflect their own regional or industry needs—for example, to tailor instruction so that youth may find immediate employment in their own community—there are equally good arguments for creating a single national system to promote equality of educational opportunity. The solution to this dilemma is to accommodate the twin goals of state sovereignty and national consistency, and to do so with limited federal action.

1) Promote development of national frameworks

To coordinate industry standards-drafting efforts, consensus frameworks could be developed that focus state and national activities around a set of common goals. Ideally, these voluntary frameworks would draw from ongoing national, state, and industry efforts to define standards that reflect the best thinking in the field. In order to develop these frameworks, the federal government may want to pursue the following approaches:

- **Specify a common lexicon**—Defining a common language can facilitate national skill standards discussions. Presently, such terms as "skill," "standard," and "cluster" mean different things in different states. Defining a common vocabulary can assist states in sharing best practices, while at the same time promoting the development of a consistent national system.

- **Seek consensus on career clusters**—Many agree that it would be worthwhile to identify a number of broad industry sectors, such as Health Care, in which initial work can begin. Efforts should also be made to clarify appropriate occupational clusters within each sector and to coordinate with professional education associations, such as the National Board for Professional Teaching Standards, to ensure that teachers receive training and licensure in similar cluster areas.

- **Provide exemplary skill standards models**—Examples of exemplary standards that detail the industry content, underlying academics, and relationships between the two can assist industry and state groups as they begin to draft standards. The existing work of state and industry projects can form a basis for developing initial models.

To help unify state efforts, the federal government could initiate efforts to recognize and disseminate a common vocabulary and structure for exemplary models of skill standards. Approaches such as those pioneered by the National School-to-Work Office, in which states, employers, and other national agencies have jointly built consensus on common terminology, may be most successful. To circulate terms to a wide audience of state policymakers, teachers, and administrators, the federal government may want to create a formal institution, similar to the National School-to-Work Clearinghouse, and use the electronic dissemination capabilities available over the Internet. Alternatively, given the linkages observed between most state industry skill standards and school-to-work efforts, it may be most efficient to harness the resources of the School-to-Work Clearinghouse to communicate skill standards information.

Discussions with state policymakers revealed that the federal government has already contributed to state skill standards projects. In fact, skill standards developers in all states reported consulting, and in many cases adopting all or parts of standards identified in the 22 national industry skill standards pilot projects. The federal government might consider funding additional pilot projects within identified clusters, or endorsing industry groups (from within consensus clusters) to sponsor continued standards development. Given the wide acceptance that national pilot projects such as the Health Care Standards have received, it is important to understand why some skill standards have been more influential than others.

The federal government might also consider sponsoring forums to enable state, industry, and academic standards developers to share their ideas and experiences. During the site visits to four states, it became apparent that policymakers have limited opportunity to learn from one another: travel constraints and an absence of written materials often mean that state systems develop in relative isolation. Discussions with representatives from the national industry pilot and academic standards projects revealed a similar lack of communication. Opportunities for national industry and academic standards developers to meet can offer linkages that eventually promote development of integrated curricula at the state and local levels.

2) Create an infrastructure to assist educators

Academic teachers may ultimately determine the fate of industry skill standards as an education reform measure. During interviews with local educators, the research team learned that only if industry standards provide a useful context for teaching essential knowledge and skills will teachers adopt them into their instructional repertoire. To increase this likelihood, the federal government may want to work with state, industry, and academic and professional groups to disseminate skill standards and promote their application for teaching and learning. Unless academic educators fully understand how standards can improve their professional practice, skill standards developers run the risk of simply recasting traditional vocational edu-

cation programs, and in so doing, dilute the potential benefits of industry skill standards to enhance learning for all students. To increase educator access to standards, the federal government might consider supporting the following efforts:

- **Crosswalk industry and academic standards**—To assist educators in teaching abstract knowledge and skills using concrete, real-world applications, skill standards developers may explore developing skill crosswalks that link industry skills to associated academic concepts.

- **Develop standards that link to higher level academic skills**—Industry standards must provide all educators, from those teaching introductory to advanced courses, with real-world examples that can be used to provide a context for instruction. While defining broad industry clusters can help overcome this obstacle, it may also be necessary to define standards for a range of entry-level as well as more advanced occupations within a specific cluster area.

- **Create inventories of instructional applications**—Inventories of exemplary lessons, projects, scenarios, and assessments can assist instructors in designing course materials. Ideally, these resource materials would provide teachers with examples of integrated curriculum, and would be readily accessible via electronic and other forms of communication.

While it is clear the federal government can help to shape the process, ultimately state and industry standards groups may want to specify the core academic and work skills required to perform specific occupational tasks. This may mean that industry representatives invite educators to work with them to connect academic subject matter with technical skills, or rely on third-party organizations to relate academic concepts to industry-specified knowledge. While it is also possible that industry groups could design and package their own instructional curricula, introducing industry standards into classrooms will likely fail if teachers are excluded from the development process, or if they are provided with "canned" curricula that specify their actions too precisely.

3) Model system development after skill standards in the professions

Standards have long been used in four-year colleges and universities to prepare undergraduate and graduate students for entering the professions. Many strategies used by professional organizations could help inform the development of a national system. Typically, professional standards influence the structure and content of program curricula by ensuring that coursework is progressive in structure, that the content promotes a global perspective of the profession, and that instruction emphasizes integrating theoretical and applied learning.

Also, to ensure that their instruction is relevant, curriculum is developed by those most familiar with the subject—the faculty. Instructors use a variety of methods to keep abreast of changes within the field, including research, consulting, hiring adjunct lecturers, and coordinating work-based learning opportunities. Finally, faculty often use field placements and performance-based assessment techniques to provide opportunities for students to integrate theoretical with applied knowledge.

Summary

In closing, conversations with state policymakers and local practitioners in each of the case study sites indicate that the development of skill standards is proceeding slowly. Since policymakers are often using standards as part of a more comprehensive education reform package tailored to meet their own state needs, organizing frameworks and skill specificity vary widely. Moreover, although national and professional associations' standards are often consulted, generally each state is defining its own set of industry standards, and is doing so with little input from academic educators or professional models. An emphasis on the technical skills associated with specific occupations has also made it difficult for most teachers to understand how industry skill standards may affect their instructional practices. If industry skill standards are to help all students prepare for education and career success, then federal and state policies should stress constructing consistent national frameworks that support the integration of academic and industry skills, as well as the design of curricular materials that can help educators apply skill standards in their day-to-day practice.

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